

BRIDGER-TETON NATIONAL FOREST

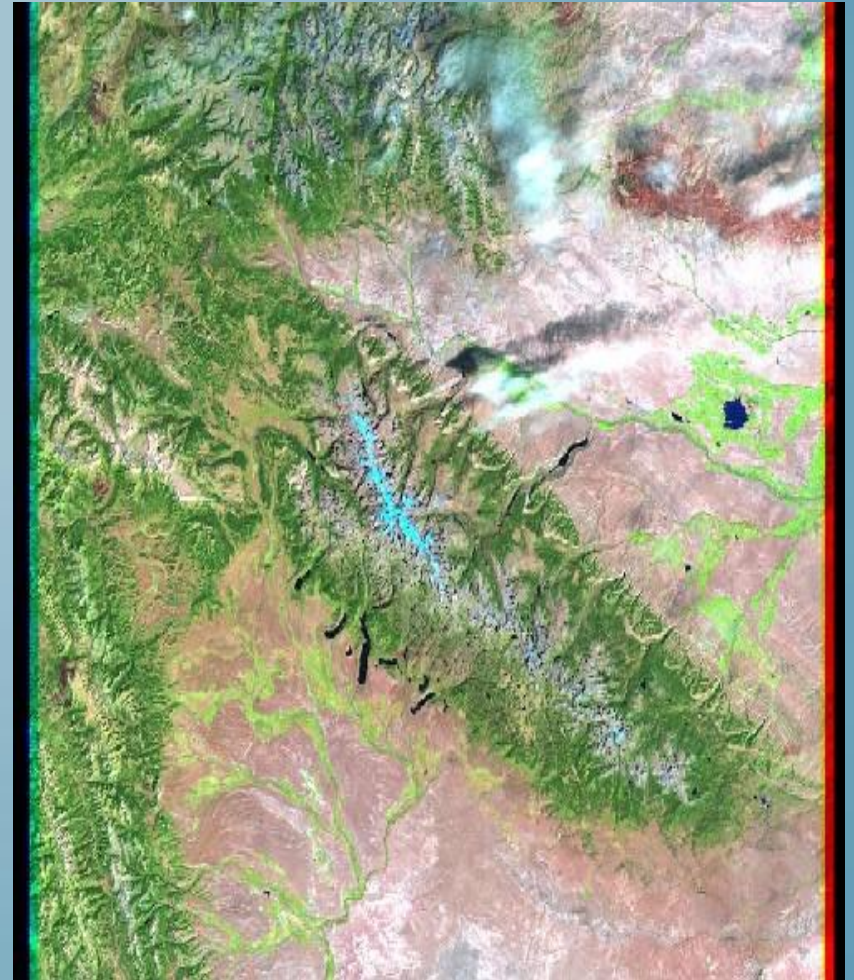
AIR QUALITY DATA SUMMARY

AUGUST 9, 2012



OVERVIEW

- *IMPROVE Visibility Monitoring*
- *NADP Monitoring*
- *Bulk Deposition Monitoring*
- *Lake Chemistry Monitoring*
- *Critical Loads Development*
 - *Lichen Studies*
 - *GYA Studies*
- *Smoke From the Fontenelle Fire*



IMPROVE MONITORING

INTERAGENCY MONITORING OF PROTECTED VISUAL ENVIRONMENTS

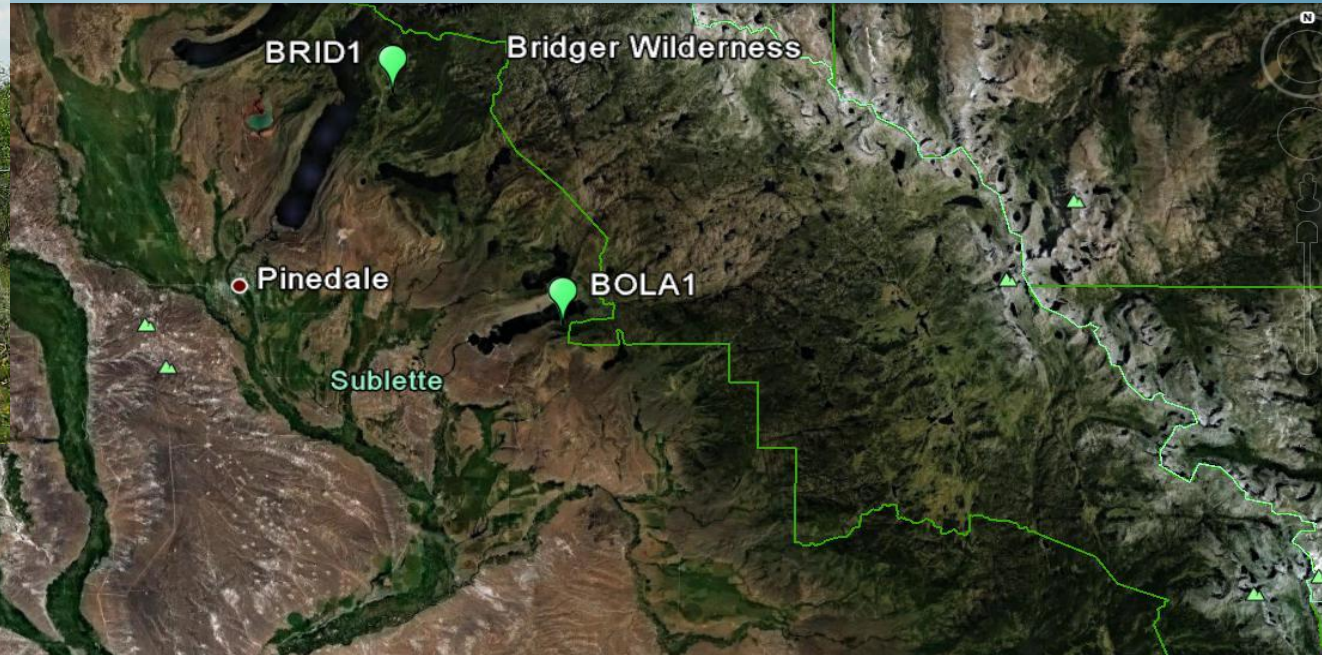


Image USDA Farm Service Agency

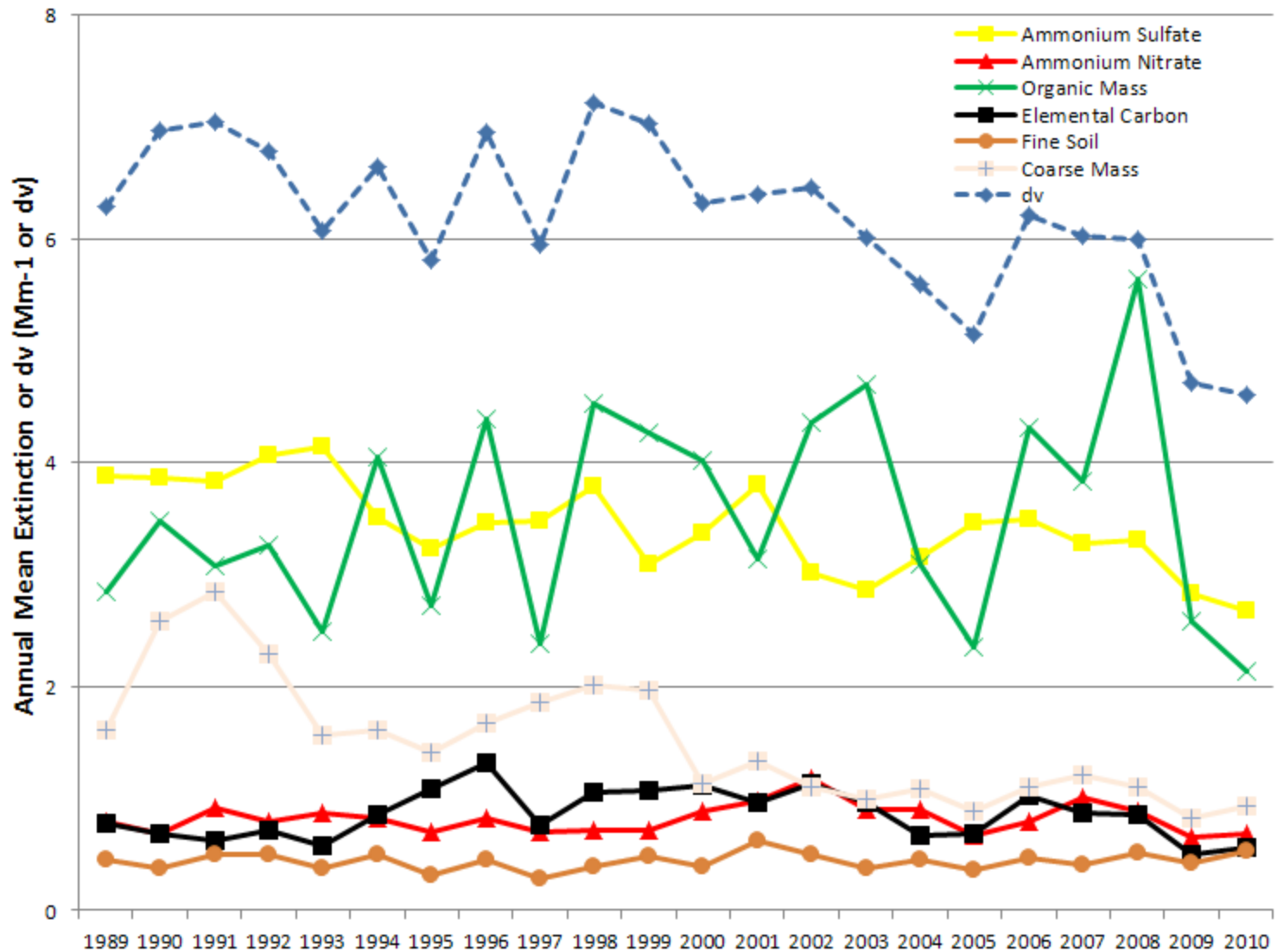
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Image © 2011 DigitalGlobe

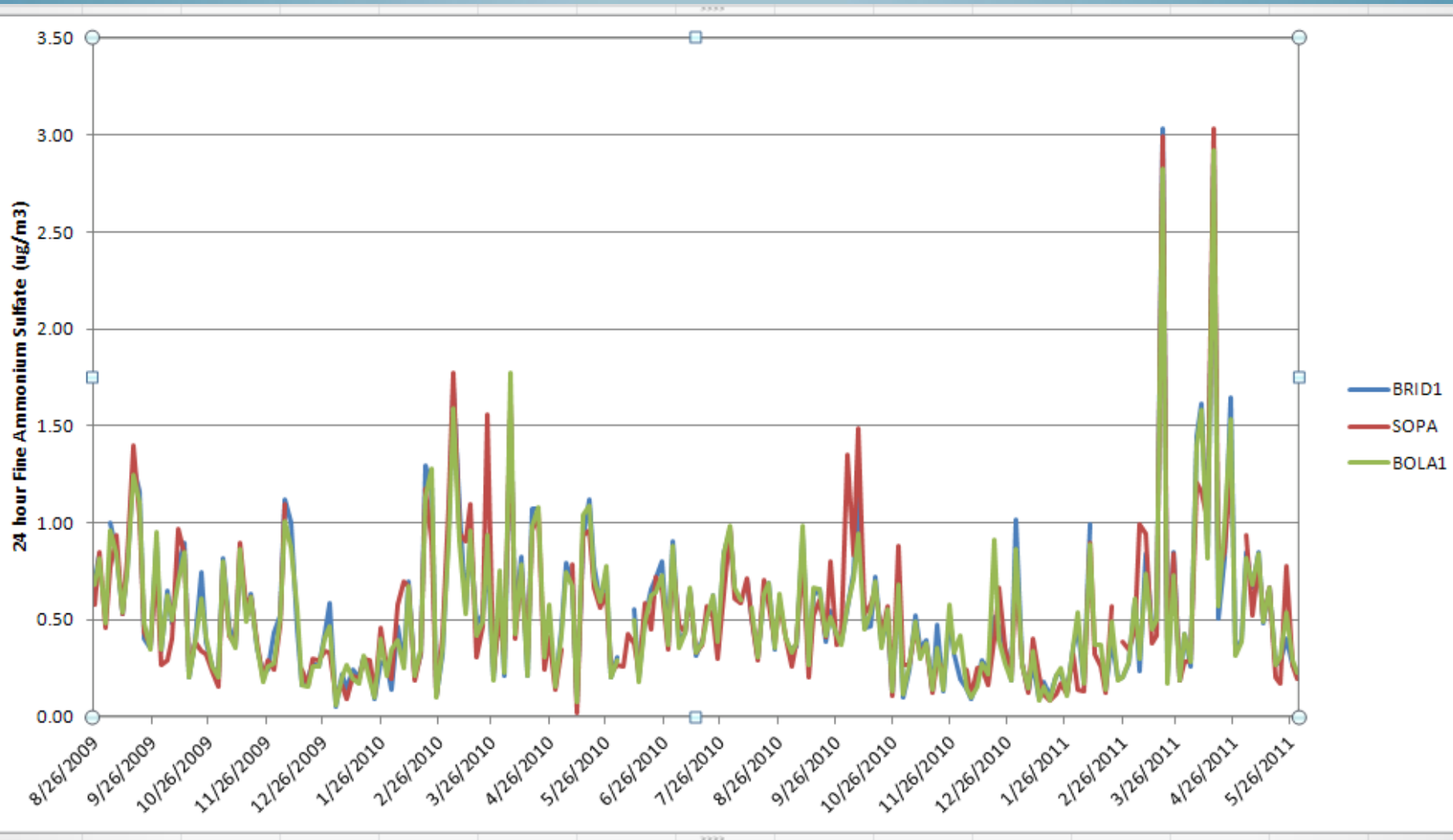
lat 42.725459° lon -109.762171° elev 7085 ft

Imagery Date: 7/4/2009

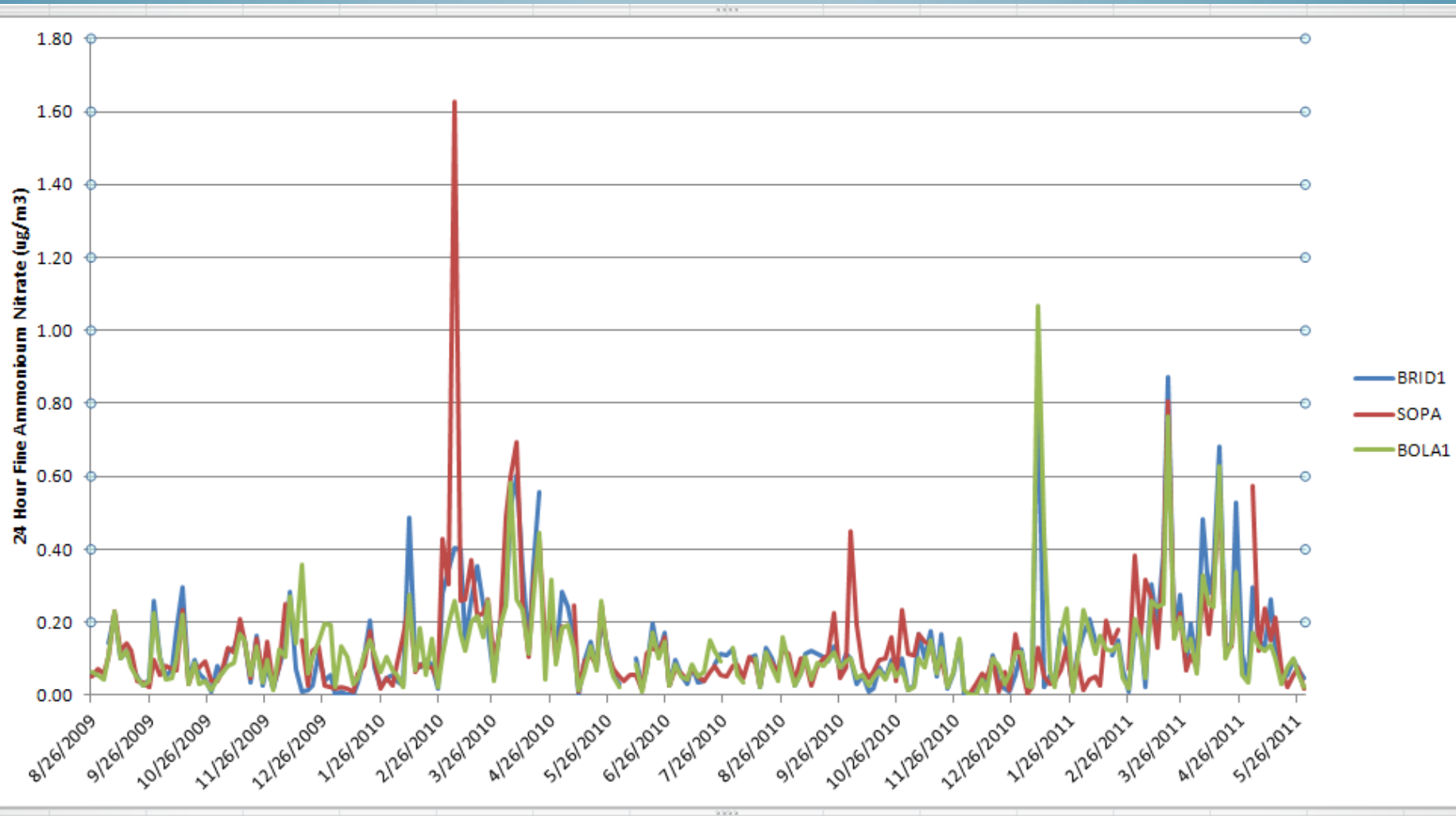
BRID1 IMPROVE Site Long Term Trends



Comparison of Ammonium Sulfate Concentrations



Comparison of Ammonium Nitrate Concentrations



IMPROVE DISCUSSION

- **In general, the three IMPROVE sites show similar trends, with some localized events.**
- **Some of the spikes noted in the data are not easily explained.**
- **Need more data and specific discrete events to conduct plume modeling and look at a broader mix of meteorological inputs.**
- **With installation of BOLA site delayed to 2009, we might have missed the peak impacts.**

DEPOSITION MONITORING

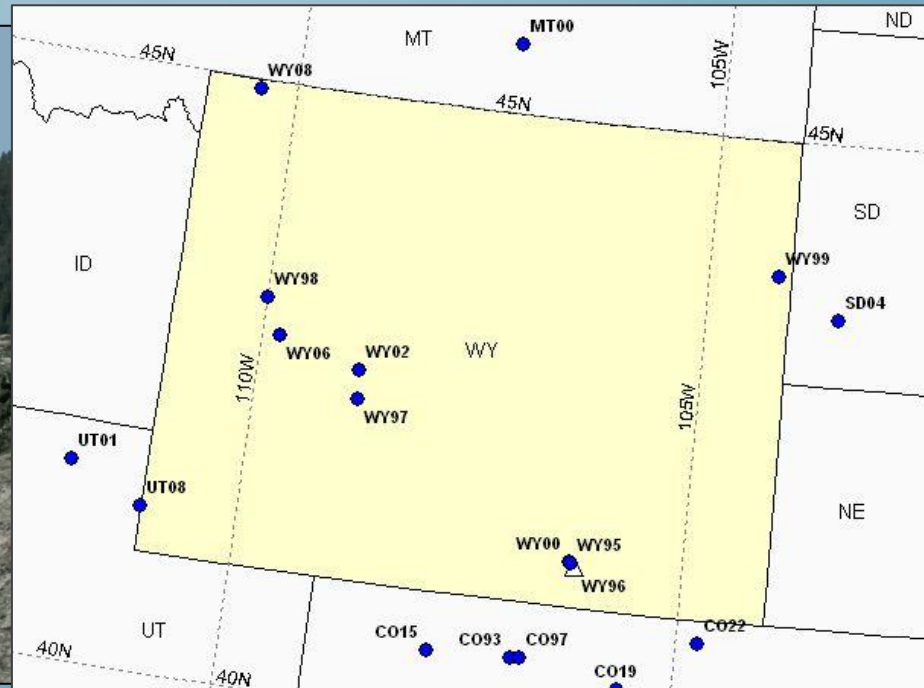
- BTNF Monitoring
- NADP (National Atmospheric Deposition Program - Measures Wet Deposition.)
- Bulk Deposition
(Measures dry and wet deposition at high elevations)



- Other Monitoring
(supported by the BTNF)
- CASTNet (EPA – Dry Deposition)
- Snow Surveys (USGS - Annual Samples)
- Passive Ammonia Studies
(NPS)

NADP Annual Trends (1986-2009)

Variable	Yellowstone (NPS)	Gypsum Creek (BTNF)	Murphy Ridge (BLM)	Pinedale (BLM/BTNF)	Sinks Canyon (BLM)	South Pass (BTNF)
NH4	↑	↑	↑	↑	↑	↑
NO3	—	—	—	—	—	↑
SO4	↓	↓	↓	↓	↓	↓



ANNUAL BULK DEPOSITION TRENDS AT HOBBS AND BLACK JOE COLLECTORS (1984-2009)

Variable kg/ha	Hobbs (BTNF)	Black Joe (BTNF)
NH_4^+	*** ↑	** ↑
NO_3^-	*** ↑	* ↑
Total N	*** ↑	** ↑
SO_4^{2-}	---	---
Precipitation	** ↑	---

* = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$, **** = $p < 0.001$



SIGNIFICANT TRENDS FOR LONG-TERM LAKES (1984-2009)

	Black Joe (BTNF)			Hobbs (BTNF)			Deep (BTNF)			Ross (SNF)			Lower Saddlebag (SNF)		
	Inlet	Outlet	Hypo	Inlet	Outlet	Hypo	Inlet	Outlet	Hypo	Inlet	Outlet	Hypo	Inlet	Outlet	Hypo
ANC	–	–	–	–	↓	–	–	–	–	↓	↓	↓	↓	–	–
NH4	–	↑	↑	↑	↑	↑	–	–	↑	ND	ND	ND	ND	ND	ND
NO3	↑	–	–	–	–	↓	–	–	↑	↑	–	–	↑	–	↑
SO4	↑	–	–	–	–	–	–	–	–	–	↓	↓	–	–	–
ND=Not Determined															



Critical Load Development

Why are high elevation areas in GYA at risk?

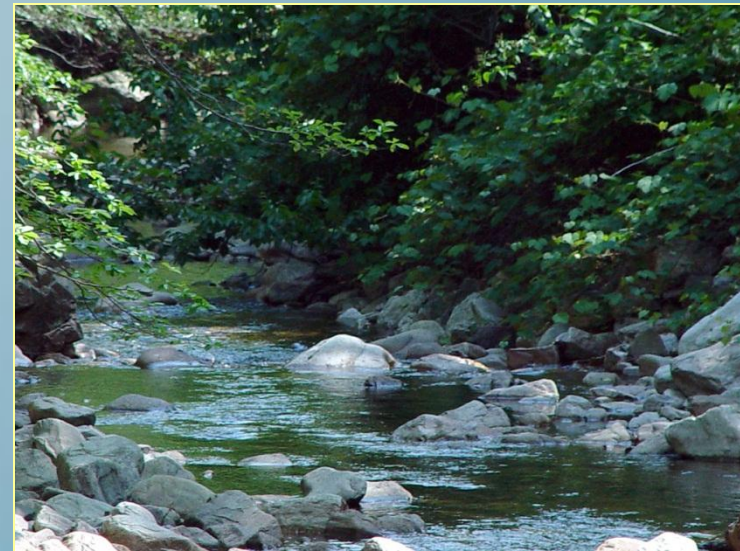


- Shallow soils
- Granitic bedrock
- Scant vegetation
- Higher precipitation/deposition
- Lakes, soils and plants are sensitive to N Inputs (Eutrophication)

Good ecosystem science can be used to develop a sound basis for pollution reduction strategies

Critical loads are established by scientists by determining cause and effect (how much deposition causes change to some part of an ecosystem)

Target loads are goals that can be established by FLMs, states or other stakeholders to designate how much or how fast we want ecosystem recovery to occur



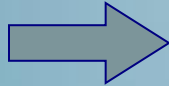
Critical loads and target loads can be developed for any pollutant- (usually Nitrogen & Sulfur)

AIR QUALITY IMPACT THRESHOLDS

Pollutant Load

SO₄, NH₄, NO₃
Hg, POPs
NO_x, SO₂

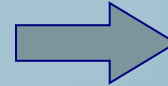
Annual averages
Seasonal patterns



Chemical Variables

ANC, pH, Nitrogen,
Base Saturation, Ca/Al

Annual averages
Seasonal extremes



Biological Responses

Death of Indicator species, Decline in
Condition of individuals
Decreased Reproductive Success

Loss of species
Change in biodiversity



“Critical Load”-

deposition loading at which
something happens in an
ecosystem

“Ecological Threshold” -

Chemical or biological limit defining when
“something happens” in an ecosystem

Greater Yellowstone Ecosystem: Continuum of Impacts to Ecological Health with Increasing Nitrogen

N Load
(kg/ ha /yr)

Alpine Plant
Critical Load =
4.0 kg/ha/yr

Terrestrial Ecosystem
Health (lichen) Critical Load
= 3.0 kg/ha/yr

Current N deposition in GYE
high elevation areas = 2.5-
3.5 kg/ha/yr avg.

Aquatic Ecosystem Health
(diatom) Critical Load
= 1.5 kg/ha/yr (wet dep only).

Natural background N
deposition
~0.5 kg/ha/yr

Changes in water
chemistry

Increase in
“weedy” lichen
species

Change in
macroinvertebrate
diversity

Effects on aquatic
animals (episodic
acidification)

Forest decline
(acidification
effects on trees)

Increase in “nitrogen
loving” aquatic diatom
species

Surface water N
saturation (NO₃
at lake outlet)

Change in alpine
plant diversity

Lethal effects on fish,
other aquatic animals
(chronic acidification)



ONGOING GYA STUDIES FOR CRITICAL LOAD DEVELOPMENT

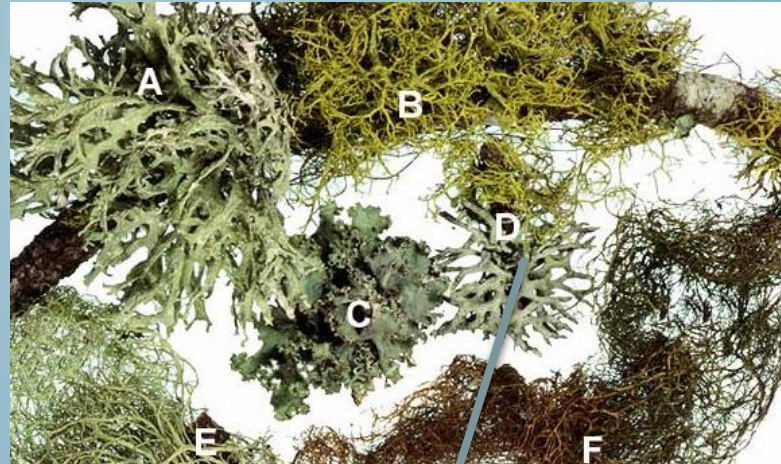
- **NADP (FS, BLM, NPS)**
- **Bulk Deposition (FS)**
- **IMPROVE (FS, NPS, WY DEQ*)**
- **Lake Chemistry (FS)**
- **Diatom Research (NPS, FS)**
- **Passive Ammonia Studies (NPS)**
- **Deposition Modeling (NPS, FS)**
- **Analysis of historical data
(macroinvertebrates) (FS)**
- **Lichen Studies (FS, NPS)**

lichen studies

Oligotrophs (large forage, nesting, habitat spp)

WHY LICHENS?

- *N addition shifts lichen community composition, favoring eutrophs at the expense of oligotrophs*



N addition



Eutrophs (small, weedy)

Epiphytic Lichen Communities, Air Quality, and Climate in the Northern Rocky Mountains



Photo: Stephen/Sylvia Sharnoff

Jill Grenon (MSU, USFS)



Photo: Linda Geiser



Photo: Karen Dillman

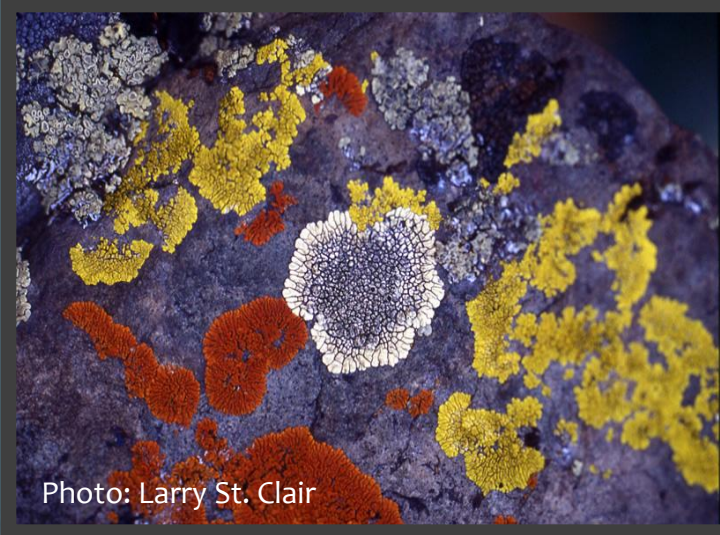
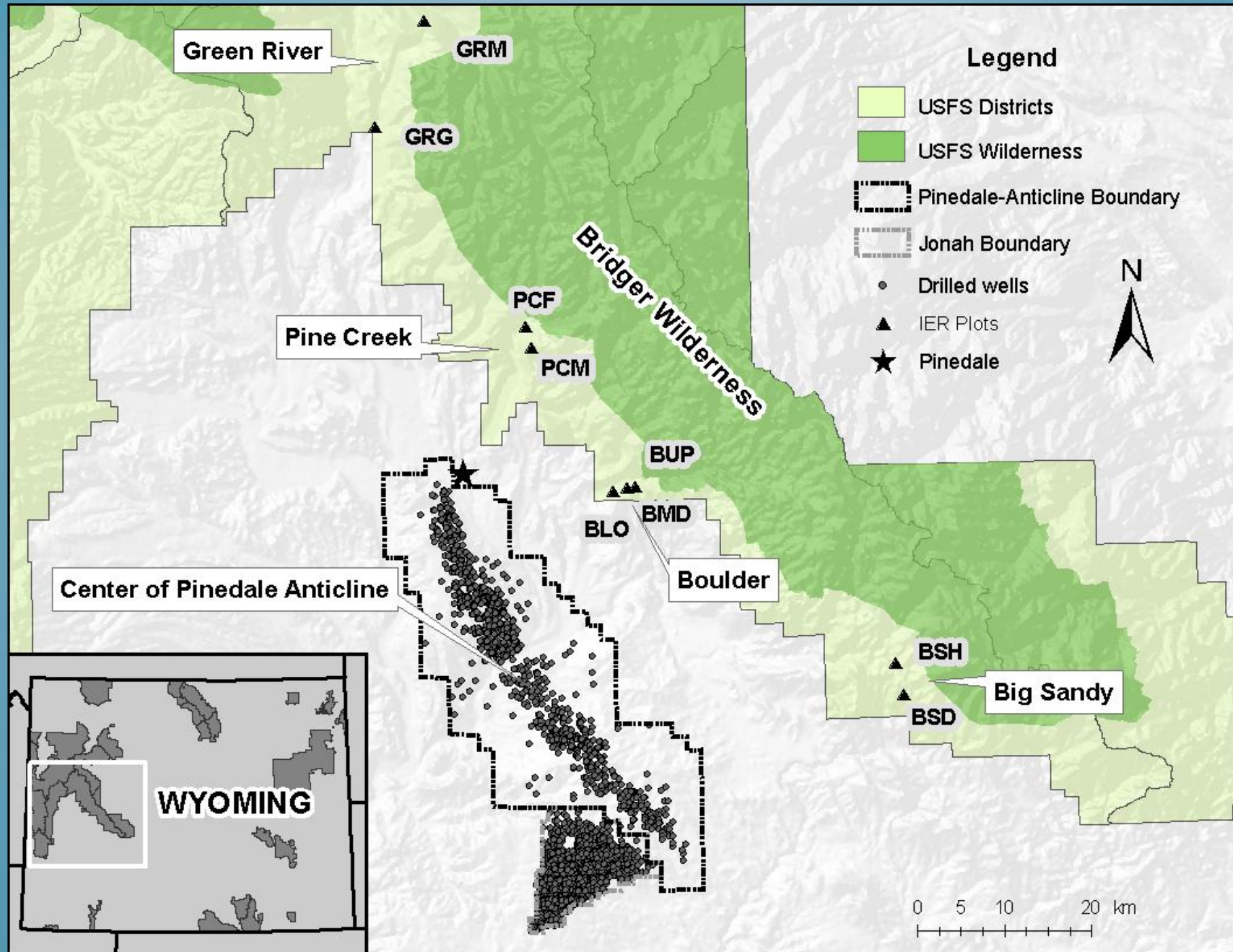


Photo: Larry St. Clair

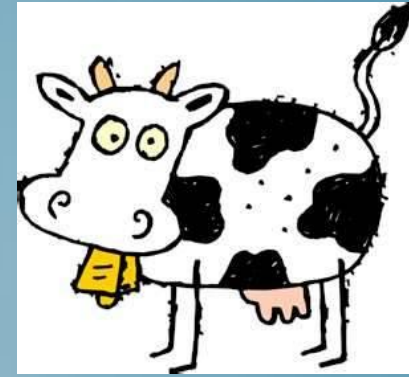


Photo: Scot Gill

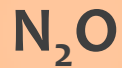


NITROGEN

Reduced N



Oxidized N



DIN = reduced N + oxidized N

FIELD METHODS

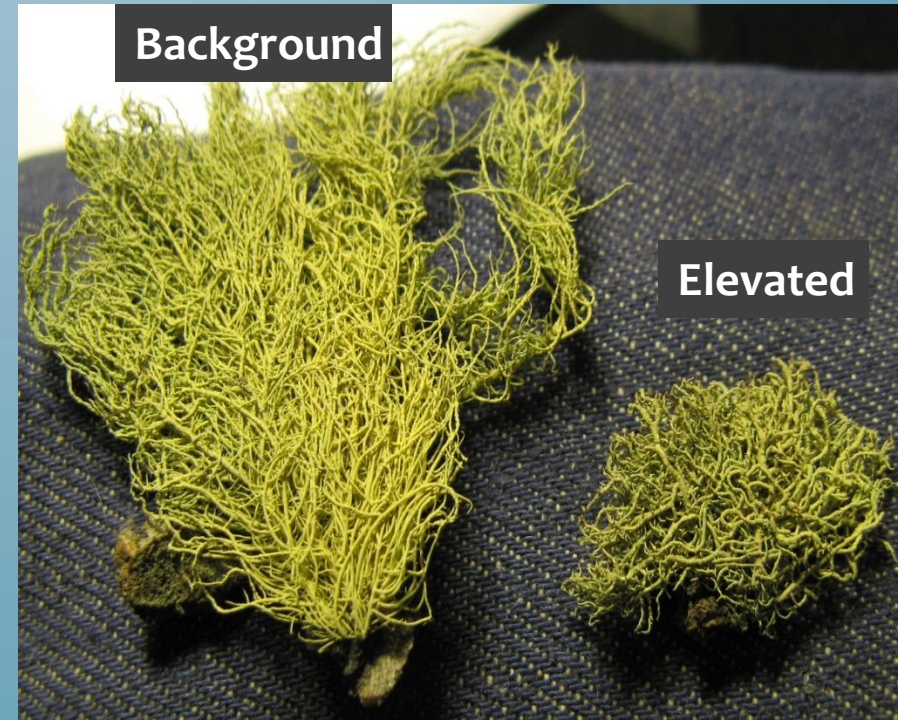
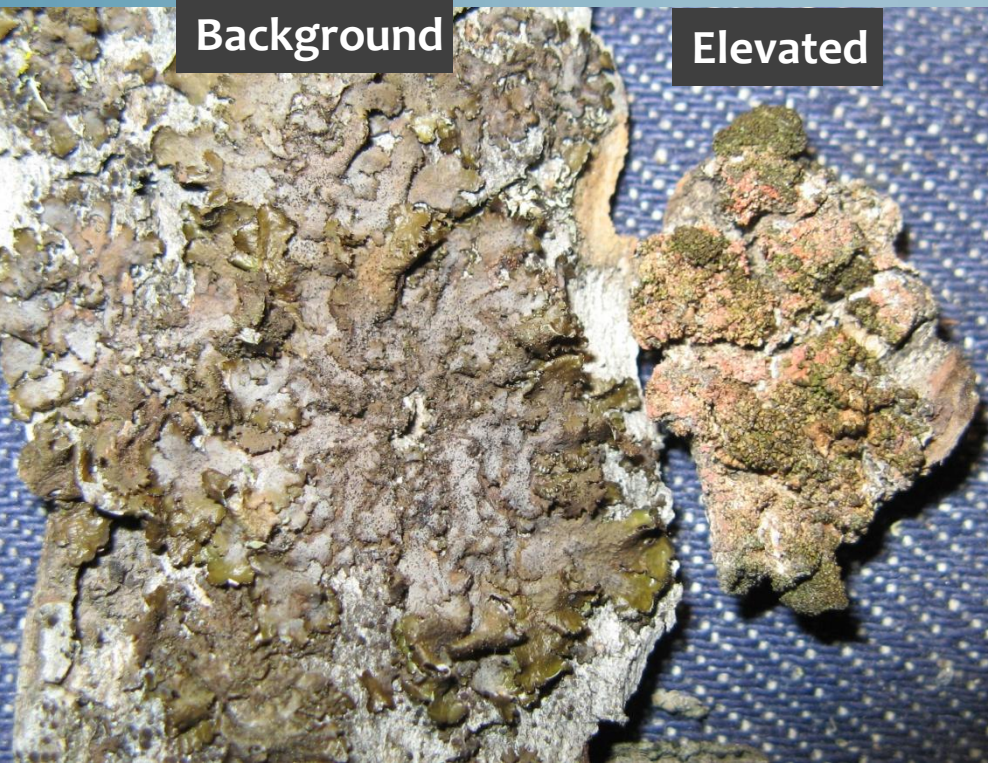
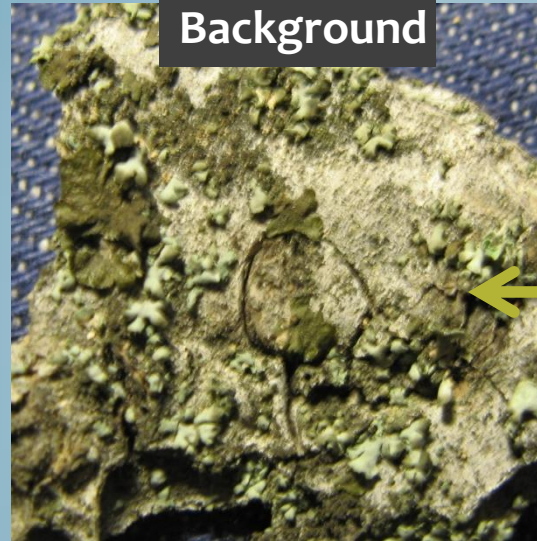
Deployed 121 Ion Exchange Resin Monitors (IER)



Empirical observations

Boulder Drainage

- Elevated N
($> 4.0 \text{ kg ha}^{-1} \text{ year}^{-1}$)
- Background N
Conditions



CONCLUSIONS

1. *N concentrations in lichen thalli can be used to estimate N deposition in the Wind River Range.*
2. *N deposition in the Boulder drainage is elevated ($\text{BLO} > 4.0 \text{ kg ha}^{-1} \text{ year}^{-1}$) with clear empirical evidence of damaged lichen thalli.*
3. *All other drainages are near background conditions which implies a local and not a long-distance source of N pollution.*

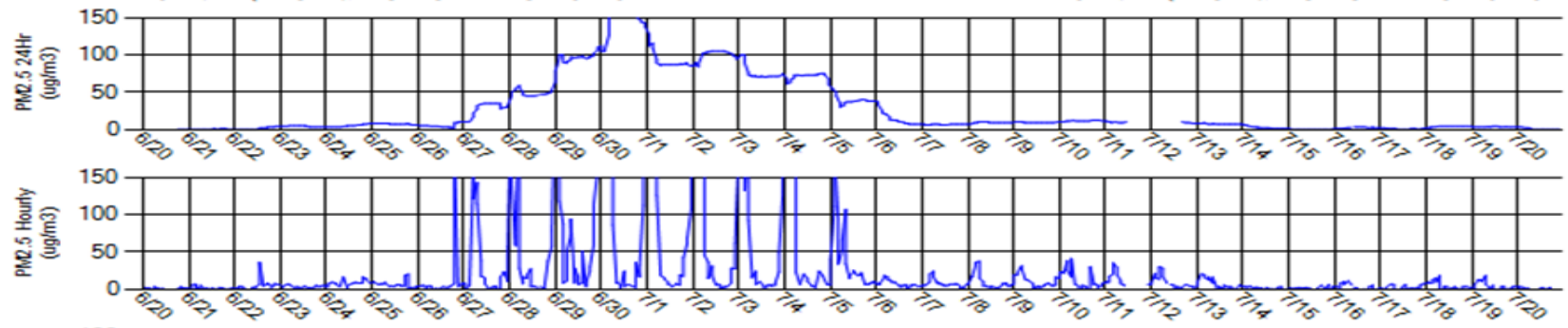
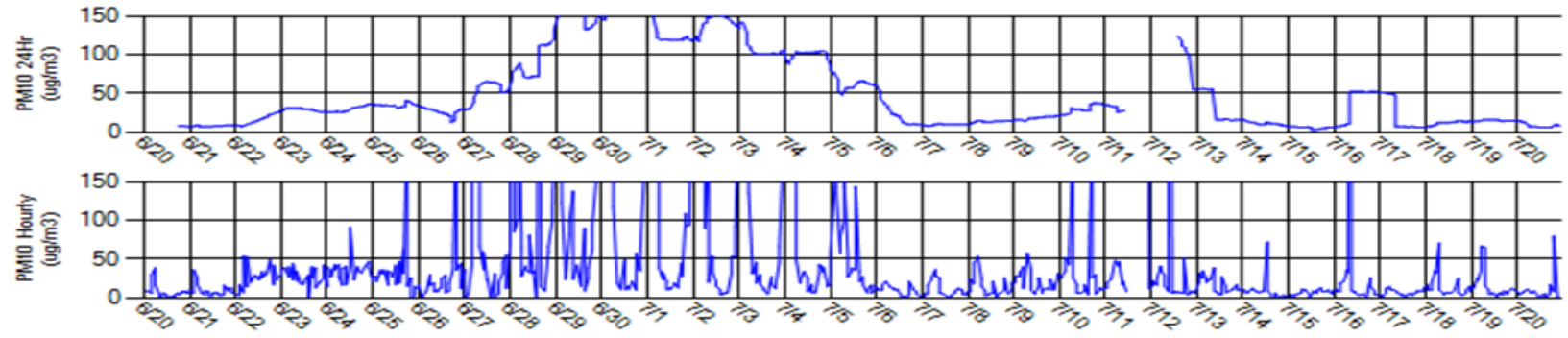
SMOKE ISSUES FROM THE FONTENELLE FIRE

JUNE-JULY 2012

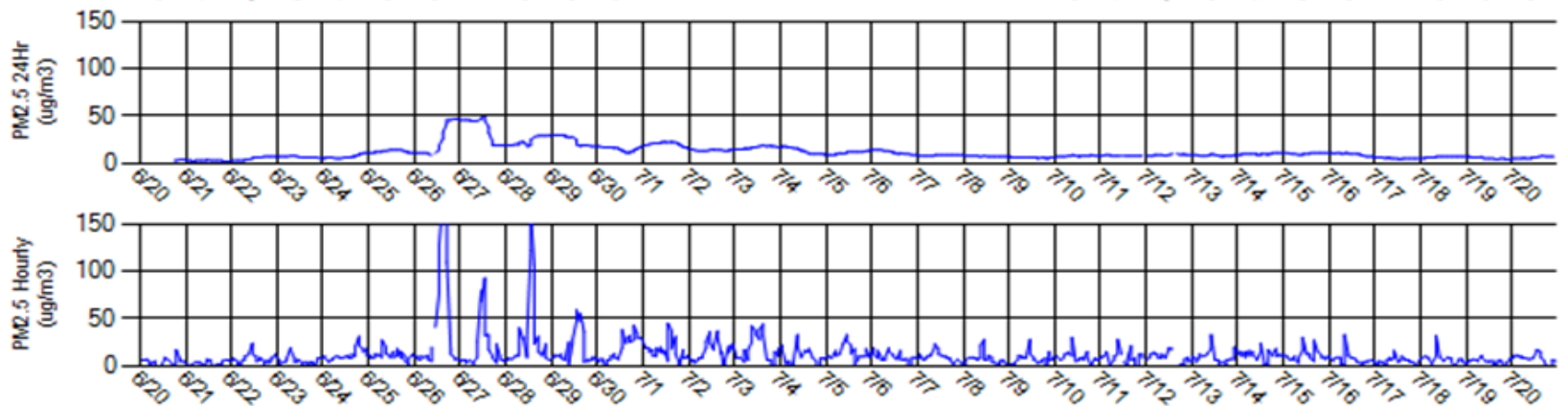


PM INCURSIONS IN BIG PINEY & PINEDALE

Big Piney



Pinedale



24Hr-PM10= 150
24Hr-PM2.5= 35

SMOKE IS A HEALTH CONCERN

- Under the EPA Regulations, smoke related to natural wildfires is considered an emergency action which is typically exempt from conformity requirements.
- Exceedances of *National Ambient Air Quality Standards* recorded on monitors related to wildfire smoke are documented by the State as “Exceptional Events” , and provided to the EPA for evaluation and concurrence.
- WY-DEQ monitors (in UGRB) measure smoke conditions and WY Dept. of Health issues warnings when appropriate.

OVERALL CONCLUSIONS

- **Visibility** - Monitors show no significant differences at this time, though they do show localized events.
- **Deposition (NADP, Bulk)** – In general show increases in ammonium, which may contribute to overall increases in N deposition. Decreases in sulfate.
- **Long-Term Lakes** - Lake Chemistry shows overall increases in N, with decreased ANC at some lakes. Eutrophication and decreases in ANC are big concerns.
- **Lichen Studies** – Have shown value in predicting areas of high N deposition. Identified local hot spots for N deposition, and have demonstrated a cause-effect relationship.
- **Other Studies** – The FS will continue to support other studies in the GYA to access and define critical loads as a tool to use in resource protection and management.
- **Fire** – Fire can be a natural process or, it can be man caused. The general rule is, extinguish man caused fires, and let natural fires burn to benefit the natural conditions on the ground with consideration of safety and infrastructure. While many fires occur on FS lands, WY-DEQ and the EPA are the regulators for smoke emissions.

QUESTIONS?

